

THE MINERAL INDUSTRY OF

ZAMBIA

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Minerals continued to be the source of about 90% of Zambia's foreign exchange earnings, estimated to be equivalent to more than \$1 billion, in 1994. Copper accounted for more than 75% and its byproduct cobalt for more than 10%. Gemstones, mostly emeralds, also recorded significant earnings, but probably an even larger amount bypassed official channels. The landlocked country was normally among the world's 6 largest producers of copper ore, refined primary copper, and refined cobalt, and reputedly the single largest in volume (40%) of emeralds. Mineral commodities production, covering a wide variety of metallic, industrial, and fuel minerals as well as copper (see table 1), was estimated to contribute between 15% and 20% to gross domestic product (GDP), which was estimated at more than \$7 billion (purchasing power equivalent)—\$800 per capita—in 1993.² The industry employed about 15% of the country's wage-earning work force of approximately 400,000. The minerals sector was also the major source of Government revenue, even though agriculture accounted for about 20% of GDP, and manufacturing, about 25%.

Resources of those minerals in production generally were extensive, including separate, unexploited deposits in various areas, and occurrences of other potentially valuable minerals were widespread geographically in the Texas-sized country. Significant nickel and fluorspar deposits were known. Some geological characteristics indicate additional possibilities, such as phosphate, diamond and petroleum. However, few were definitively explored, particularly if they were more than 100 kilometers (km) from the so-called "line of rail" running roughly north-south of Lusaka on the more developed and populated, 1,000-meter (m)-high, gently rolling, central plateau.

The northeastern part of the country has generally higher, rougher terrain; the southwestern part is generally lower in elevation with marshes and sandy flats. About one-half of the country, mostly the central plateau, is cropland and pasture, and most of the rest is forest consisting mostly of second-growth savanna woodland with swamps fairly common in the western half. The Zambezi River, forming much of the southern border, drains a large part of the country. Despite the latitude, the moderate elevation provides a mild, subtropical climate with three distinct seasons—warm and wet from November to April, cool and dry from April to August, and then hot and dry.

Geologically, Zambia—lying between two ancient cratons, Zairean and Zimbabwean—has aspects of both mobile belts

and cratons. Consequently, the geology is complex, but conducive to a variety of valuable mineralization. More than two-thirds of the country is underlain by Precambrian rocks having only moderately thick soil cover. The highland in the northeast is Precambrian basement of granite surrounded by sedimentary and metamorphic rocks with a few small basic intrusions. The basement hosts such minerals as gold, nickel, and asbestos. Proceeding southwesterly and southeasterly, the basement is overlain unconformably by successively younger formations. In the north-center of the country, southwest of the basement exposure, are the major copper-cobalt deposits occurring in late Precambrian sediments of the Katanga group, mostly carbonaceous marine shales and graywackes. In the east, younger Karoo sedimentary rocks with an occasional basaltic flow are common in the several rift valleys as well as in normally eroded river valleys. Karoo formations also underlie a thick cover of more recent Kalahari windblown sands in the western third of the country. The Karoo hosts coal and uranium.

Government Policies and Programs

Zambia's economy was dependent on one commodity, copper, for several decades prior to independence from the United Kingdom in 1964. After the nationalization of mines in 1970, the one-party, socialistic Government's increasing use of mineral earnings for various purposes, while neglecting the need for reinvestment in the industry, led to a progressive decline in copper production and revenue. Domestic refined copper output in fiscal year 1994 was slightly more than 350,000 metric tons (mt), after having peaked at almost 700,000 mt in 1976. Following a peaceful, multiparty election of a new market-oriented Government in October 1991, a stringent economic reform program previously agreed upon by the Government with the World Bank and International Monetary Fund was more rigorously pursued. Some of the Government actions included adoption of a free market in currency and interest rates, removal of price and import controls, and reduction of subsidies and trade barriers. Also, new regulations allowed retention of foreign currency earnings and repatriation of all after-tax profits, and lowered business taxes. Early in 1994, the World Bank staff considered that good progress had been made in the relatively brief time the program was in effect. Reduction in the inflation rate, a principal concern in the

program, continued to show success—the annual rate dropped from more than 100% to 35% during calendar year 1994. Nevertheless, a number of economic problems remained that required long-term efforts.

As part of the economic reform program and transition to a market economy, the new Government took steps early to privatize most of the more than 100 Government-controlled companies. Although this effort was progressing with several units in the minerals sector included among those put up for sale, the schedule and precise form of privatization of Zambia Consolidated Copper Mines Ltd. (ZCCM), the country's major single enterprise, was not resolved as of mid-1995 because of potential impact on the political situation. Several studies by international firms failed to provide a basis for consensus.

The Government continued to promote actively the private sector and seek foreign investment, particularly in minerals. It participated in a number of investment conferences starting in the early 1990's prior to an African Mining Investment Conference in Denver, Colorado in June 1994, organized by the World Bank's Multilateral Investment Guarantee Agency. A review of current production, geology, prospects, and legal matters was presented by Zambia's Ministry of Mines and Mineral Development. The Ministry also was an organizer of a Southern African Development Community (SADC)-European Union (EU) Mining Forum in Lusaka in December 1994 aimed at promoting investment.

New mining and mining investment legislation expected to be presented to the parliament in 1995 was aimed at attracting risk capital, technology, and entrepreneurial efforts to the mining sector. The laws resulted from several outside studies and World Bank and consultant reviews, as well as long and somewhat contentious intra-Government discussion. The legislation's intent was to be comprehensive and to improve the economic and operating environment for mining companies. The law was to have its own investment provisions paralleling those in the latest revision of the general investment law as well as incorporating changes already made to other existing Zambian legislation. It also was designed to reflect successful legislation in other countries of SADC. All mineral commodities were to be covered. Early information indicated large-scale, small-scale, and artisanal operations were each to be treated separately as to mineral rights (prospecting and mining authorizations) and taxation. Among other provisions reported were secure title to mining rights with provision to assign; right to market products; international arbitration; exemption from import duties and sales taxes on material, at least for an initial period of exploration and development; royalty on net return at the mine ranging from 3% on base metals to 5% on gemstones, possibly with deductions dependent on value added in processing; and income tax somehow tied to market prices starting with a base rate of 33%—apparently a maximum—with deductions allowed for capital redemption, royalty, and any indirect taxes.

A World Bank-financed technical assistance project to the Ministry of Mines and Mineral Development began in 1993.

Components covered additional geological mapping; improving assaying and mineral processing test facilities; setting up a database of mining titles and resources; as well as studies on small-scale mining assistance, mining policy, and restructuring the Ministry.

In December 1994, the Government announced its policy to no longer participate in new exploration or become a shareholder in a mining company, and to limit its functions to regulatory or promotional activities.

Environmental Issues

Parliament's Environmental Protection and Pollution Control Act (No. 12) of 1990 (EPPCA) formed the basis for a Ministry of Environment and Natural Resources and also an Environmental Council of Zambia. The act formally came into full force in February 1992 and gave the Ministry overall responsibility for protecting the environment. The council was formed with representatives from mining, manufacturing, forestry, agriculture, academia, government, and the public. Its first task was to establish standards and limits for discharges of all kinds for inclusion in regulations.

ZCCM had followed a self-regulatory approach to environmental protection for some time. It established standards based on limits elsewhere in the world. After the EPPCA came into full force, ZCCM put into place an appropriate management structure with the help of consultants under a World Bank Technical Assistance package. It was among the major companies of the 25 that comprised the nongovernmental International Council on Metals and the Environment founded in 1991 to promote sound environmental and health practices. That Council was coordinator and cosponsor with two United Nations units and the World Bank of a Conference on Development, Environment and Mining in Washington, DC, in June 1994. In April 1994, ZCCM commenced a more intensive 2-year program of personnel education, discharge measuring, formal reporting, mass balance studies, monitoring stations installation, and conceptual rehabilitation planning.

Production

Copper and cobalt output continued to fall—15% and 33%, respectively—in 1994. Lower grade feed, geotechnical and mining equipment problems, low concentrator recovery, and smelter operational difficulties at various units were blamed. Lead and zinc production ceased with the closing of the Kabwe Mine in June 1994 owing to uneconomic operations. Cement production apparently also declined, as did reported gemstones and coal. The latter reduction was said to be the result of equipment problems as well as lower demand, particularly from Nitrogen Chemicals of Zambia Ltd. Petroleum refinery products output probably were lower, based on reports of operating difficulties, but numerical information was not available for estimating any decline. (*See table 1.*)

Trade

The major mineral exports were copper and cobalt (also zinc and lead, in order of value, until 1994). However, some observers believed gemstones were very significant in export value for some time, possibly second to copper, despite the absence of official records. Although official published trade data were unclear, based on ZCCM sales of cobalt, copper, lead, and zinc, the EU was the leading destination for exports for a number of years, with Japan a close second. Cobalt and copper were also among the principal exports to the United States, which was not a significant trading partner in any case.

The major import by far was petroleum, including crude and refined products. Fertilizer components were the second largest mineral import, particularly phosphorus and potassium (limited quantities of some nitrogen compounds were made domestically). Structural steel was another important import of mineral origin. The Arabian Gulf States were a principal source of imports because of oil purchases. South Africa was also a principal source of imports, at least partly because of transshipments from overseas sources. Mining equipment was normally the largest import from the United States.

Structure of the Mineral Industry

The Government still dominated the industry, although the tempo of efforts at privatization appeared to be increasing. The state-owned Zambia Industrial and Mining Corp. Ltd. (ZIMCO), scheduled for phase-out in 1994, but apparently still functioning early in 1995, held a majority interest in all principal commercial and industrial ventures other than those privatized. ZCCM, the largest entity in the minerals sector, was owned 60.3% by ZIMCO, 27.3% by Zambia Copper Investments Ltd. (owned 50% by Minorco S.A., in turn, owned more than 60% by the Anglo American Corp.-DeBeers Centenary AG group), and 12.4% by the public, including institutions. A Small Mines Development Unit of ZCCM supported at least one mine for gemstones in Eastern Province and one for gold, as well as one for copper in Western Province. Other units also produced lime and marble, and ZCCM also owned shares in several ventures not related to minerals.

Divestiture of ZCCM's noncore businesses began in 1992. A restructuring plan developed by ZCCM late in 1993 apparently led, in 1994, to the first ZCCM mineral unit being offered for sale—the Kabwe Division, which produced zinc, lead, and pyrite (for sulfuric acid) prior to closure in June 1994, although the pyrite operation (a separate mine, Nampundwe) presumably would be retained by ZCCM. At yearend 1994, the Chambishi underground copper mine of ZCCM, shuttered in 1987, was formally tendered for sale. Earlier in the year, the Government also included the Luanshaya smelter (shut down in January 1994) in an announcement of intended sales or joint venture offerings and also the Kansanshi copper mine, operated by the Copper

Mining Enterprise Trust, apparently a venture of ZCCM and/or the Government for training unemployed workers that was managed by ZCCM.

Privatization plans for the entire ZCCM remained unresolved. Although studies by various consultants had been completed by mid-1994, as of early 1995 the Government still had not yet formally announced any schedule or how much of its interest in ZCCM was to be sold and whether to sell as several separate operating companies or a single integrated unit. Because of the complexity of the privatization and especially the lack of a national consensus, action was likely to be delayed until after the 1996 elections, according to press reports in late 1994. Meanwhile, all options were to be re-examined. Early in 1995, Anglo American Corp. of South Africa Ltd. (AAC) was reported to have agreed with the Government to jointly make a 24-month technical and financial audit of ZCCM before privatization proceeded further.

The Government's privatization program and new investment and mining acts were expected to result in the formation of a number of new private companies. Among companies that demonstrated some interest in Zambia's mineral sector, especially privatization of ZCCM or its components, were five of the world's eight largest private mining organizations: RTZ Corp. Plc. (RTZ) of the United Kingdom; AAC; Broken Hill Pty. Co. Ltd. (BHP) of Australia; Phelps Dodge Corp. (PD) of the United States; and Gencor Ltd. of South Africa. A number of other large and small international—South African, British, Canadian, Dutch, and Australian—and small Zambian companies also were active.

ZIMCO also had a Mineral Exploration Department that worked outside ZCCM's properties and also provided services to other subsidiaries.

Other ZIMCO subsidiaries in the minerals sector included wholly owned Reserved Minerals Corp., which, in turn, owned 100% of Mindeco Small Mines Ltd. (producer of several industrial minerals) and 55% of Kagem Mining Ltd. (reportedly the country's largest gemstone producer, 45% of which was owned by the Hagura organization, a private partnership); Chilanga Cement Co., 60% or more owned through Indeco Ltd., another wholly owned subsidiary of ZIMCO, with an unspecified share owned by Commonwealth Development Corp. of the United Kingdom (the Zambia Government's 60% was formally tendered for sale in late 1994); wholly owned Nitrogen Chemicals of Zambia Ltd., producer of ammonia and compounder of fertilizers and explosives; wholly owned Maamba Collieries Ltd., the country's sole coal producer; and Indeni Petroleum Refinery Co. Ltd., 50% owned through Indeco Ltd. with at least some portion believed owned by Agip SpA. of Italy, the operating manager. Additionally, among more than 100 companies, ZIMCO also had majority or full ownership of some minerals-related businesses, such as crushed stone, glass, and ceramics firms; Metal Marketing Corp. of Zambia, a minerals and metals trading firm; as well as Tazama Pipelines Ltd. (the crude oil pipeline from Dar es Salaam),

Zambia Railways Ltd., domestic and international airlines, and electric utilities.

Private entities operated a number of small mines for which little information was available. More than 20 such mines were producing gemstones. Others produced limited quantities of gold, apparently mostly alluvial, as well as tin and a variety of industrial minerals.

Commodity Review

Significant exploration was being conducted throughout the country. More than 70 separate licenses were in effect covering large areas, especially the northwest, southeast, and much of the areas surrounding ZCCM's mine sites. In addition to copper-cobalt and lead-zinc ores, the companies targeted gold and nickel minerals, diamonds and other gemstones, fluor spar, and phosphate. Several international mining groups were involved, such as BHP and Western Mining Corp. Ltd. from Australia; SouthernEra Resources Ltd. from Canada; Billiton International Metals BV from the Netherlands (acquired by South Africa's Gencor in mid-1994); AAC, Gencor, Johannesburg Investment Co. Ltd., and Trans Hex Group Ltd. from South Africa; RTZ; PD; and a number of smaller ventures.

Recovery of cobalt, copper, lead, and zinc from tailings and slag dumps on ZCCM and other properties were of interest to several companies.

Metals

Cobalt.—As a result of the substantial decrease in 1994 output, as well as increases in other countries, ZCCM's world ranking as a cobalt producer also fell. The cause of the shortfall was attributed to mining constraints (ground control problems at Baluba Flat; equipment, grade, and rain problems at Nchanga open pit; and a shortage of ore, especially the higher-sulfur type needed in processing, at the Nkana operations) as well as process equipment problems at Nachanga's concentrator. Studies aimed at increased production focused on improved recovery (using solvent extraction and other new hydrometallurgical technology) and treating smelter slags.

Recovery of cobalt from old ZCCM copper smelter slag was planned by a Zambian firm, Qassim Mining Enterprises Ltd. (QME). At yearend 1994, Colossal Resources Corp. of Vancouver, Canada, had acquired a 60% interest in the slag processing venture and apparently will provide financing. In September 1994, QME was reported to have obtained 25-year rights from ZCCM to recover cobalt from one-half of a 16-million-metric-ton slag dump at Nkana, near Kitwe, about 300 km north of Lusaka. The grade was said to average 0.7% to 0.8%, ranging from 0.33% to 2.6%. Early in 1995, preliminary plans were to send 300 to 600 metric tons per day by railroad to Kabwe, where some ZCCM facilities could be used. Cost of the project was given as \$16 million. Apparently, a proprietary thermal process of a South African firm, Technology and Energy Management Services used in

Zaire, was being considered. It reportedly produced copper and a high-cobalt ferroalloy.

Caledonia Mining Corp. of Toronto, Canada, applied for prospecting permits for cobalt in three areas.

Copper.—Privatization of ZCCM was of major interest to the entire industry. The total cost of fully revitalizing the company to reach and maintain the desired 450,000-metric-ton-per-year (mt/a) production level, which at mid-1994 had risen to an estimate of more than \$3 billion during a 15-year period, was an important factor in determining the format for returning the company to the private sector. Joint ventures with outside firms on specific divisional projects was also being considered.

Development of deeper ore at the Konkola Mine at the northwestern end of the Zambian Copper Belt was the focus of immediate attention. A 1,470-m-deep shaft would allow mining of several hundred million metric tons grading more than 3% copper. It was crucial to the survival of ZCCM because it was needed to replace the reserves nearing depletion at the Nchanga open pit. The cost to achieve production of the desired 6 million metric tons per year of ore was given at about \$650 million. Late in 1994, the Government was seeking foreign loan and/or equity capital for the project that would retain control by ZCCM. It was unclear whether the Government and ZCCM had earlier rejected or counter-offered an AAC proposal to form a consortium to develop the mine as an independent venture with ZCCM as a minor participant.

ZCCM offered the Chambishi and Kansanshi Mines for sale about mid-1994. Chambishi, on the Copperbelt, had published resources of 136 million metric tons (Mmt) at 2.4% copper. Kansanshi, near Solwezi northwest of the Copperbelt, with resources of more than 26 Mmt at 2.9% copper with significant gold, was operated as a training facility and to provide jobs for employees considered excess at other operations. At yearend 1994, two offers on Chambishi were reportedly being examined—one from an Italian firm and one from an Indian consortium.

The Lumwana deposit, about 250 km west of the Copperbelt center of Kitwe, was the focus of a PD exploration project. Prior indicated mineralization was more than 1 billion mt averaging 0.7% copper.

Gold.—The Government indicated a special interest in seeing an increase in gold production, particularly to foster developing a jewelry industry. A number of smaller international companies were said to be showing interest, although no news of any exploration or development appeared in the press during the year.

Lead-Zinc.—ZCCM officially closed the Kabwe lead-zinc mine, about 110 km north of Lusaka, on June 30, 1994, and at yearend was planning to "open the bidding" on assets the first week in January 1995. At that time, ZCCM said there was no possibility of reopening as had been considered by

Boliden Contech of Sweden after a preliminary study late in 1994.

Retreatment of Kwabe waste continued to be discussed by several parties, but no further action was reported.

Nickel.—The Munali nickel sulfide deposit, about 50 km south of Lusaka, was revived as a project early in 1994 by the concession-holder Appolo Mining (Pty) Ltd., a private Zambian company, and its partner, Claims Minerals NL of Australia. Reserves were given as 10.4 Mmt at 1.1% nickel. Claims Minerals was to acquire a 60% interest by investing \$1.5 million.

The Kalumbila deposit, about 460 km northwest of Lusaka (50 km west of Lumwana), was to be investigated by AAC. Earlier studies gave resources as 8 Mmt at 0.55% nickel.

Industrial Minerals

Cement.—Chilanga Cement Ltd., with plants at Lusaka and Ndola on the Copperbelt having capacities rated at 200,000 mt/a and 300,000 mt/a, respectively, was first announced for sale by the Government in 1993. Formal action still was pending at yearend 1994.

Diamond.—Alluvial diamond, known for some time to occur in the Musondweji River basin about 400 km west-northwest of Lusaka, were to be explored by Caledonia Mining Corp. of Toronto, Canada. Locating the source was of special interest. A De Beers unit was working on diamond exploration in western Zambia in late 1992. Several smaller international firms applied for concessions in the northwest and in the south along Lake Kariba and the Zambesi River.

Fluorspar.—No results were announced with regard to discussions between Agip SpA. of Italy and the Government about possible development of a fluorspar deposit about 120 km south of Lusaka. Significant infrastructure costs were a restraint on exploitation.

Gemstones.—The Ministry of Mines and Mineral Development continued a program to further develop production of gemstones other than diamonds found in many parts of the country. Training and other assistance was being provided to small local mine operators. The agency believed the sector should also be attractive to foreign investment in mining, processing, and marketing.

Emeralds, mostly produced about 200 km north of Lusaka (Ndola rural area), were estimated to normally comprise about 80% of total gemstone production in value. In volume, however, amethyst output, mostly from a location about 300 km south-southwest of Lusaka (Kalomo area), usually was the largest reported. Additionally, there was production of aquamarine and tourmaline, mostly from a location about 600 km northeast of Lusaka (Lundazi area), as well as garnet, agate, and other gemstones at a number of locations.

Of the 30 to 40 registered gemstone operations reported,

2 were larger-size, mechanized mines that were joint ventures with the Government. From 200 to several thousand small, unregistered mining operations were estimated to be operational.

Nitrogen.—Nitrogen Chemicals of Zambia Ltd. continued to be reported as having financial and production problems with two coal-based ammonia plants originally commissioned in 1970 and 1981. However, no details were available.

Talc.—Although only a small production of talc was reported for many years, two locations were known to have operations in the past. Talc Zambia Ltd. began mining at the Mushishi deposit, identified as being near Ndola on the Copper Belt in 1989. Reserves were given as 2 Mmt containing 33% steatite. The initial output rate in 1989 was about 30,000 mt/a of several grades, for sale domestically as well as export to buyers in Zimbabwe and South Africa. Government-owned Crushed Stone Sales Ltd. mined the Lilayi talc deposit, south of Lusaka. It was listed for privatization early in 1992 because operations were not very efficient.

Mineral Fuels

Coal.—Maamba Collieries Ltd.'s strip mine in southern Zambia continued to produce with difficulties. Equipment outages and lack of orders appeared to be perennial problems. A World Bank-funded study to determine the long-term viability of the mine was begun in October 1992 by John T. Boyd Co. of Pennsylvania, but results were never announced.

Petroleum.—In December 1994, the European Investment Bank offered Zambia a \$22 million loan to cofinance a 3-year, minimum \$51-million petroleum sector restructuring project. Earlier in the year, the World Bank's International Development Association (IDA) approved a \$30 million credit toward the then-estimated \$48 million project. Tazama, the Tanzania-Zambia pipeline company, and a new Zambia Oil Co. reportedly were to fund any balance, which was expected to be in domestic currency. A major portion of the project, \$45 million, was for rehabilitating the Tazama pipeline from the port of Dar es Salaam, Tanzania, to the Indeni refinery at Ndola on the Zambian Copper Belt. The balance was split about equally for rehabilitating the refinery facilities and for improving the management structure.

Reserves

Copper ore reserves of ZCCM were ample for at least 15 years of continued full-scale operation at 450,000 mt/a of finished copper, according to ZCCM officials. ZCCM's Annual Report for the year ended March 31, 1995, gave total ore reserves for the seven operating mines as 291 Mmt

averaging 2.98% copper. Additional mineral resources of ZCCM were huge, 1.26 billion mt at 2.5% copper. A number of other known copper deposits outside of ZCCM's license area were known as well. The major deposit was Lumwana with resources of more than 1 billion mt at 0.7% copper.

Cobalt reserves associated with copper ore at three of ZCCM's mines totaled 123 Mmt averaging 0.15% cobalt and 2.33% copper. This did not include reserves at Nchanga totaling 8.57 Mmt at 0.62% cobalt.

Gold ore resources were being studied by several groups and appeared to be extensive. Many occurrences were located throughout the country, some around and to the east of Lusaka.

Lead-zinc reserves at former operations were limited, but additional resources were known at several locations. Resources projected at Kabwe were more than 50 Mmt at 3.8% zinc and 1.7% lead, including some waste dumps, but most were low grade or not readily mined.

Nickel resources at the Munali sulfide deposit were put at 10.4 Mmt at 1.1% nickel with minor copper, gold, silver, and platinum-group metal content. The Kalumbila deposit had resources estimated at 8 Mmt at 0.55% nickel. Neither deposit was fully defined and extensions were to be explored. Additional resources are projected at other sites.

A large variety of other metallic minerals deposits also were known, but needed further exploration. Most work apparently was on iron, molybdenum, and tin-tantalum.

Of the many industrial mineral resources that were being exploited or studied by commercial groups, gemstones were of the most value, but others included clays for brick and tile, and for refractories; fluorspar; gypsum; limestone for cement and lime manufacture; magnetite for special purposes; marble; phyllite, probably for cement manufacture; silica, mostly for glassmaking; and talc. Phosphate resources were known, but only of low grade, one of which was a carbonatite in the northeast, the subject of continuing studies by Government agencies.

Mineral fuel resources were reported at 250 Mmt of bituminous coal, but estimate details were not available. Petroleum resources remained conjectural with no known activity after some surveys in 1990 along the Zambesi River east from Victoria Falls to Mozambique.

Infrastructure

A reasonably adequate truck road and railway network existed within the country and externally for access to ocean and lake ports for international trade. Major highways generally paralleled the rail lines. About 20% of the main roads were paved and about 20% were gravel or stabilized earth. In 1993, the World Bank's affiliated IDA considered the road system to be essential to economic growth but neglected for years, and gave an \$8.5 million credit to restructure the Government system and begin planning for rehabilitation. In early 1995, this resulted in \$800 million in pledges for rehabilitation from the World Bank and other

donors.

The principal rail routes were northeast to and from the port of Dar es Salaam, Tanzania—nearly 2,000 km from Ndola in the Copperbelt—mostly on the Tanzania Zambia Railways Authority (Tazara) line; and south through Zimbabwe to and from South African ports—more than 2,500 km from Ndola—using the Zambia Railways Ltd. line in Zambia. The roughly 2,000-km rail link southeast to the port of Beira, Mozambique, through Zimbabwe, became generally available after a long hiatus due to civil war in the port country; but ocean ship availability apparently was limited. The more than 2,200-km rail link north into Zaire and west to the port of Benguela (Lobito), Angola, remained unavailable because of political unrest, especially in Angola. For copper exports, a southeasterly route involving trucks to Grootfontein in Namibia and then rail to the port at Walvis Bay on the South Atlantic Ocean was also being used starting in 1990, despite appearing to be of limited advantage. The rail system, in general, still had some rolling stock shortages, and track maintenance on internal routes was of concern, but equipment rentals and donor aid programs helped to improve the situation.

A crude oil pipeline ran from Dar es Salaam about 1,700 km southeast to a refinery in Ndola. It was owned and operated by Tazama Pipelines Ltd., a joint venture of the Zambian and Tanzanian Governments.

International and domestic air transport were generally considered excellent.

Electric power capacity was adequate, furnished about 70% from hydroelectric, 20% from oil, and 10% from coal plants. Expansion of hydro sources was planned despite the effect of periodic droughts. Coal was available from domestic deposits. The energy source for mobile equipment continued to be imported petroleum, mostly refined products, although a significant amount imported was crude that was refined in the state-owned facility at Ndola. The household energy source was wood, which thus continued to be the country's largest single source of energy.

Telecommunications were considered very good, both internally and externally.

Outlook

Zambia's economic difficulties could remain a problem for some time because of the many impediments to the reform program that was so essential to eventual resolution of the difficulties. However, much promise of success could be found in the availability of good agricultural, mineral, and water resources; the open political environment; and a market-oriented Government, together with the continued reasonable personnel and financial assistance from international sources. With continued political stability and passage of the anticipated improved mining and mining investment legislation, the international mining community could be expected to act more vigorously on the opportunities. A number of minerals appeared ripe for development. Copper-cobalt output in the short term was

likely to decline owing to restructuring and operating problems, but improved efficiency and reinvestment of earnings could bring a turnaround. Nevertheless, production was expected to again decrease in the longer term unless there was substantial outside financing very quickly.

¹Text prepared Oct. 1995.

²The World Factbook 1994, U.S. Central Intelligence Agency, Washington, DC, 1994, 512 pp.

Major Sources of Information

Ministry of Mines and Minerals Development
P.O. Box 31969
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Telephone: 260-1-251-403
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Mines Development Department
P.O. Box 31969
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Geological Survey Department
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Telephone: 260-1-251-570
Facsimile: 260-1-251-973

Major Publication

Investment Opportunities in the Mineral Sector of Zambia, Ministry of Mines and Mineral Development, Lusaka, Zambia. (Paper presented at African Mining Investment Conference, June 6-8, 1994, Denver, CO) Multilateral Investment Guarantee Agency of the World Bank, Washington, DC, 1994.

TABLE 1
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/ METALS	1990	1991	1992	1993	1994
Beryllium: Beryl kilograms	1,630	836	504	178	857
Cobalt: 3/					
Mine output:					
Ore milled: 4/					
Gross weight thousand tons	6,510	6,310	6,630	6,500 r/	5,390
Co content	10,900	11,000	11,400	9,480 r/	6,750
Concentrate:					
Gross weight	259,000	244,000	226,000	221,000 r/	225,000
Co content	7,000	6,990	6,910	4,840 r/	3,710
Metal:					
Materials treated:					
Gross weight	262,000	283,000	260,000	244,000 r/	260,000
Co content	6,670	7,100	6,970	4,920 r/	3,770
Refined electrolytic cathode	4,670	4,740	4,800	3,710 r/	2,480
Copper: 3/					
Mine output: 5/					
Ore milled:					
Gross weight thousand tons	23,000	21,500	22,700	22,000 r/	19,800
Cu content	519,000	476,000	538,000	507,000 r/	449,000
Concentrate:					
Gross weight thousand tons	1,340	1,100	1,100	1,060 r/	962
Cu content	400,000	344,000	367,000	344,000 r/	290,000
Metal:					
Electrowon from:					
Tailings leach	67,800	70,600	80,400	84,100 r/	83,400
Copper concentrate leach	12,400	11,100	--	--	--
Cobalt concentrate leach	24,400	28,200	27,300	27,200 r/	26,300
Total electrowon	105,000	110,000	108,000	111,000 r/	110,000
Smelter output, blister/anode 6/	332,000	300,000	356,000	305,000 r/	241,000
Total electrowon and blister	436,000	410,000	464,000	416,000 r/	351,000
Refined:					
Electrorefined 7/	335,000	314,000	376,000	306,000 r/	252,000
Shapes 8/	50,500	42,900	52,400	57,400 r/	32,700
Subtotal	385,000	357,000	428,000	363,000 r/	285,000
Electrowon 9/	52,700	45,400	43,700	48,800 r/	67,300
Total refined grade	438,000	402,000	472,000	412,000 r/	352,000
Gold 3/ 10/ kilograms	129	136	271	235 r/	124
Lead: 3/					
Mine output, ore milled:					
Gross weight	158,000	177,000	114,000	128,000 r/	--
Pb content	9,640	9,080	4,450	7,030 r/	--
Metal:					
Smelter bullion, gross weight	5,340	5,000	3,950	-- r/	--
Refined, gross weight 11/	3,670	2,640	3,030	2,000 r/	--
Manganese concentrate (e/ 48% Mn), gross weight	712	662	292	-- r/	--
Selenium, refined, gross weight 3/ 12/ kilograms	21,700	21,900	31,800	26,700 r/	21,300
Silver 3/ 10/ do.	17,000	13,700	21,000	16,000 r/	10,000
Tin concentrate:					
Gross weight (65% to 72% Sn)	2	9	3	-- r/	--
Sn content	1	6	2	-- r/	--
Zinc: 3/ 13/					
Mine output, Zn content of ore milled	32,100	19,800	14,700	16,700 r/	--
Metal, refined, gross weight 14/	9,720	6,340	7,290	3,450 r/	--
INDUSTRIAL MINERALS					
Cement, hydraulic	437,000	367,000	347,000 e/	310,000 r/ e/	280,000
Clays:					
Brick e/ 15/	3,730 16/	2,820 16/	3,000	3,000	3,000
Building, not further specified e/	2,000	2,000	2,000	2,000	27,000 16/
China and ball e/	250	120 16/	200	200	200
Feldspar	60	70 e/	113	100 e/	--

See footnotes at end of table.

TABLE 1--Continued
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/	1990	1991	1992	1993	1994
INDUSTRIAL MINERALS--Continued					
Gemstones:					
Amethyst kilograms	18,100	168,000	479,000	398,000	366,000
Aquamarine do.	166	65	254	74	21
Emerald do.	619	265	453	138	160
Gypsum e/ 17/	17,500 r/	14,700 r/	13,900 r/	14,000 r/	11,200
Lime, calcined thousand tons	200 r/ e/	184 e/	193 r/	206 r/	195
Limestone (cement and lime) e/ 18/ do.	930 r/	810 r/	800 r/	770 r/	710 e/
Magnetite, gross weight 19/	576	400	417	1,250 r/	1,070
Nitrogen: N content of ammonia e/	3,900 16/	4,700 16/	7,000	5,000 r/	3,000
Sand and gravel, construction e/ thousand tons	500	500	500	500	117 16/
Stone, construction:					
Limestone, crushed aggregate do.	772	739	680 r/ e/	632 r/	668
Other e/ do.	700	700	700	700	700
Sulfur: 3/					
Pyrite concentrate:					
Gross weight (e/ 42% S)	72,100	73,500	78,200	80,800 r/	55,600
S content e/	30,200	30,600	32,400 r/	33,400 r/	21,900
In sulfuric acid from: e/					
Pyrite roaster gas, S content	26,000 r/	28,000 r/	29,000 r/	30,000 r/	20,000
Metallurgical gas, S content	70,000 r/	71,000 r/	70,000 r/	56,000 r/	62,500
Total, S content	96,000 r/	99,000 r/	99,000 r/	86,000 r/	82,500
Talc	160	89	366	62 r/	76
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous thousand tons	382	345	422	301 r/	163
Petroleum, refinery products: e/ 3/ thousand 42-gallon barrels	5,300	5,300	5,300	5,300	5,300

e/ Estimated. r/Revised.

1/ Table includes data available through Oct. 1, 1995. Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; data may not add to totals shown because of independent rounding.

2/ In addition to commodities listed, the following were probably produced but information is inadequate to reliably estimate output: fluor spar (reported in 1990 at 35 metric tons; tourmaline (reported for 1990 through 1992 as at least 1 kilogram per year); additional crude construction materials at artisanal operations (clays for brick and tile; sand, gravel, and stone for aggregate and fill; dimension stone; et al); and clay and/or shale normally used for cement manufacture (about 0.4 ton per ton of finished cement). Some "industrial sand" and minor amounts of "phyllite" and "silicate" production also was reported but not further defined.

3/ Data are for year beginning Apr. 1 of year stated.

4/ Ores from which both a copper concentrate and a cobalt concentrate, or a cobalt concentrate only were produced.

5/ From mines operated by Zambia Consolidated Copper Mines Ltd. (ZCCM) only; additional concentrate estimated at about 3,000 metric tons per year is produced by other mines in Zambia. Includes ore and concentrate shown under "Cobalt" entry above, all of which contain copper that was recovered but separate quantitative data on copper content of cobalt concentrates are not available. In the Copper annual report of the USBM Minerals Yearbook, copper content of mine production is considered to be the sum of the following entries from this table: "Smelter output" plus "Total electrowon" less any metal derived from imported ore or concentrates included in either entry.

6/ Includes the following quantity of blister anodes produced on toll by Zambia Consolidated Copper Mines Ltd. from concentrates imported from Zaire (1990-1992), South Africa (1991-1993), Indonesia (1992), and Uganda (1994) in metric tons: 1990--16,200; 1991--19,700; 1992--34,600; 1993--20,200; and 1994--644. In the Copper annual report in the USBM Minerals Yearbook, smelter production is the sum of the following entries from this table: "Smelter output" plus "Total electrowon" less "Refined: Electrowon."

7/ Includes the following quantity of electrolytic cathodes (presumably refined grade) produced on toll by ZCCM from blister anodes smelted from imported concentrates (see footnote above), in metric tons: 1990--16,500; 1991--15,700; 1992--40,000; 1993--19,900; and 1994--1,600.

8/ Reported by ZCCM as "finished production, refined shapes," presumably billets and/or wirebars of refined grade produced from lower grade electrowon cathodes and/or blister anodes that were furnace- or fire-refined; although high-grade electrowon cathodes or even electrorefined cathodes cathodes could possibly have been used as well.

9/ Presumed to meet refined-grade specifications although reported by ZCCM only as "finished production, leach cathodes" apparently a portion of the total electrowon cathodes that were not further refined.

10/ From copper and cobalt refinery residue produced by ZCCM only. Additional production probably came from artisanal operations but information is inadequate to reliably estimate output. However, total production, presumably from artisanal as well as ZCCM operations, was reported for calendar years as follows, in kilograms: gold--218 in 1992, 267 in 1993, and 165 in 1994; silver--18,300 in 1992, 18,100 in 1993, and 12,200 in 1994. In year ending Mar. 1993 up to 250 kilograms of silver may have come from imported concentrates processed on toll.

11/ Reported by ZCCM as "finished production." Presumed to be primary since no use of scrap was reported by ZCCM.

12/ Presumably recovered from copper and cobalt refinery mud/slimes processed at ZCCM's Ndola Precious Metal plant. A similar quantity may be contained in mud/slimes not processed in-country and possibly sold for treatment elsewhere, but information is inadequate to reliably estimate content.

13/ Gross weight of ore milled as is shown in "Lead" above.

14/ Includes output of both Imperial smelter and electrolytic zinc plant reported as "finished production" by ZCCM.

15/ Presumably weight of finished brick.

16/ Reported figure.

17/ Estimated for cement manufacture only (about 4% of finished cement), assuming no imports. Available information is inadequate to reliably estimate output for other uses (e.g., plaster). The only production officially reported was 82 metric tons for 1992.

18/ Estimated for cement (about 1.3 tons per ton of cement) and lime (about 1.8 tons per ton of calcined lime) manufacture only. Also see "Stone, construction: Limestone, crushed aggregate."

19/ Presumably for cement manufacture, dense media, electronic, or other special uses. Estimated at 65% to 70% Fe.